b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,

c. forming a film with a specula narrow band Bragg reflection,

d. cooling the film to the room temperature at a predetermined speed,

e. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchips,

wherein the microchips having a plurality of reflection wavelengths are dispersed at least two dimensionally in the cholesteric film as a result of the thermo phase separation of the polymeric liquid crystals;

whereby a broadband diffusively reflective polarizer is formed.

2. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the layer with predetermined thickness has the thickness in the range of $5 \sim 40$ μm.
3. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the sufficiently low temperature is in the range of $-30 \sim 30^0$C.
4. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the controllable duration is in the range of $1 \sim 24$ hours.
5. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the homogenous mixture is also including a UV initiator.
6. The method of fabricating a diffusively reflective polarizer as in claim 1 further including a UV-beam exposure step to make the polarizer high-temperature stable.
7. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different mesomorphic structure.
8. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different physic-chemical miscibility.
9. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a thermoplastic polymer.

10. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a UV cureable thermo-set polymer.
11. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchip is a composite structure of polymeric liquid crystals with different proportion.
12. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchip has a diameter in the range of 5 ~ 30 micrometer.
13. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchips have at least two dimensional randomized distributions within the cholesteric film.
14. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the phase separation is a thermo phase separation.
15. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering substantially the visible bandwidth.
16. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering at least a portion of the invisible bandwidth.
17. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the narrow band Bragg reflection and the broadband diffusive reflection is inter-convertible.
18. The method of fabricating a diffusively reflective polarizer as in claim 17 wherein the conversion from broadband to narrow band is through the phase unification process.

4. Version with markings to show changes made

Claims: I claim:

1. <u>A diffusively reflective polarizer comprising:</u>
    a. <u>a cholesteric film of at least two polymeric liquid crystals having a discrete microchip structure, and</u>
    b. <u>at least one alignment layer attached to at least one surface of the film;</u>

wherein a plurality of microchips having discrete reflection wavelengths are dispersed at least two dimensionally in the cholesteric film confined by the alignment layer as a result of a phase separation process of the polymeric liquid crystals;

whereby a silver white broadband reflection of circular polarization with an approximately hemispherical viewing angle is displayed on the polarizer.

2. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different mesomorphic structure.
3. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different physic-chemical miscibility.
4. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a thermoplastic polymer.
5. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a UV cureable thermo-set polymer.
6. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure is a composite structure of polymeric liquid crystals with different proportion.
7. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a diameter in the range of 5 ~ 30 micrometer.
8. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has at least two dimensional randomized distribution within the cholesteric film.
9. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a symmetry helical axis which is normally distributed along the normal direction of the cholesteric film.
10. The diffusively reflective polarizer as in claim 1 wherein the phase separation is a thermo phase separation.
11. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers substantially the visible bandwidth.
12. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers at least a portion of the invisible bandwidth.
13. A method of fabricating a diffusively reflective polarizer comprising the step of:

a. forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,

b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,

c. forming a film with a specula narrow band Bragg reflection,

d. cooling the film to the room temperature at a predetermined speed,

c. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchips,

wherein the microchips having a plurality of reflection wavelengths are dispersed at least two dimensionally in the cholesteric film as a result of the thermo phase separation of the polymeric liquid crystals;

whereby a broadband diffusively reflective polarizer is formed.

14. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the layer with predetermined thickness has the thickness in the range of $5 \sim 40$ μm.

15. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the sufficiently low temperature is in the range of $-30 \sim 30^0$C.

16. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the controllable duration is in the range of $1 \sim 24$ hours.

17. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the homogenous mixture is also including a UV initiator.

18. The method of fabricating a diffusively reflective polarizer as in claim 13 further including a UV-beam exposure step to make the polarizer high-temperature stable.

19. A method of fabricating an inter-convertible polarizer comprising the step of: forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,

a. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,

b. forming a film with a specula narrow band Bragg reflection,

c. cooling the film to the room temperature at a predetermined speed,

d. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchip structure,

e. heating the polarizer film in the predetermined area at a sufficiently high temperature to make the discrete microchip structure to the homogenous cholesteric structure,

f. repeating step d., and e.,

whereby the diffusively broadband polarizer and the specula narrow band polarizer is interchangeable to each other.

20. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from narrow band polarizer to broadband polarizer is through the phase separation step.

21. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from broadband polarizer to narrow band polarizer is through the phase unification step.

22. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the step of heating the polarizer film in a predetermined area is a thermo-scan imaging process.

23 The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different mesomorphic structure.

24. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different physic-chemical miscibility.

25. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the cholesteric film is a thermoplastic polymer.

26. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the cholesteric film is a UV cureable thermo-set polymer.

27. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchip is a composite structure of polymeric liquid crystals with different proportion.

28. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchip has a diameter in the range of 5 ~ 30 micrometer.*
29. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchips have at least two dimensional randomized distributions within the cholesteric film.*
30. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the phase separation is a thermo phase separation.*
31. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering substantially the visible bandwidth.*
32. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering at least a portion of the invisible bandwidth.*
33. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the narrow band Bragg reflection and the broadband diffusive reflection is inter-convertible.*
34. *The method of fabricating a diffusively reflective polarizer as in claim 33 wherein the conversion from broadband to narrow band is through the phase unification process.*

Very respectfully,

Applicants: Yao-Dong Ma